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ABSTRACT

The Measurement and Evaluation Center conducted two validity studies designed to determine the test scores to be used by the Division in making decisions about credit by examination at the University of Texas Austin (UT Austin) in Biology 302, Cellular and Molecular Biology, and Biology 303, Structure and Function of Organisms. Seventy-nine summer-term students in Biology 302 took the UT Austin Test for Credit in Biology as part of their final examination. In Biology 303, Structure and Function of Organisms, 68 students took the UT Austin Test for Credit. Analysis of these results and course grades for students resulted in a recommendation that 31 be the decision score for students in the C range in Biology 302 and that 39 be the decision score for students in the C range in Biology 303. Scores for A and B grades are also recommended for each test. Seven tables present scores and findings. (SLD)

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VALIDITY STUDIES OF UT AUSTIN TESTS FOR USE IN CREDIT BY EXAMINATION IN *CELLULAR AND MOLECULAR BIOLOGY* (BIO 302) AND *STRUCTURE AND FUNCTION OF ORGANISMS* (BIO 303) SUMMER 1991

Nancy H. Bené, Barbara G. Dodd,
and H. Paul Kelley

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MEASUREMENT AND EVALUATION CENTER
The University of Texas at Austin

TM 022102

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VALIDITY STUDIES OF UT AUSTIN TESTS FOR USE IN CREDIT BY EXAMINATION IN *CELLULAR AND MOLECULAR BIOLOGY* (BIO 302) AND *STRUCTURE AND FUNCTION OF ORGANISMS* (BIO 303) SUMMER 1991

Nancy H. Bené, Barbara G. Dodd,
and H. Paul Kelley

At the request of the Division of Biological Sciences at The University of Texas at Austin, the Measurement and Evaluation Center (MEC) conducted two validity studies designed to determine the test scores to be used by the Division in making decisions about credit by examination in Biology 302, *Cellular and Molecular Biology*, and in Biology 303, *Structure and Function of Organisms*.

During the first summer session of 1991, locally-prepared tests were administered to students in Biology 302 and in Biology 303 as part of their final examinations. Test scores were then analyzed in relation to student performance, as measured by final grades, in each of the courses.

BIOLOGY 302

Method

Subjects

Seventy-nine (79) students who were enrolled in Biology 302 during the first summer term of 1991 served as subjects. Biology 302 is an introduction to structure and function at cellular and subcellular levels; an integrated approach to molecular genetics, metabolism, development, evolution, and other life processes. One year of high school chemistry or one semester of college chemistry is recommended as preparation for this course.

Materials

The UT Austin Test for Credit in Biology 302 was prepared by faculty members of the Division of Biological Sciences. It is a one-hour test designed to cover the content of the course and consists of 50 multiple-choice items.

Procedure

In the first summer term of 1991, the UT Austin Test for Credit in Biology 302 was included as a part of the final examination in Biology 302. The MEC electronically scanned the test answer sheets, calculated Number Correct scores, and delivered those scores to the faculty member responsible for evaluating students' performances. Then the relationship between final course grades and test scores was analyzed. The correlation coefficient between test scores and course grades was

computed as well as the means and standard deviations of those measures of achievement. Frequency distributions of the Number Correct Scores (0-50 scale) were crosstabulated with the Final Course Grades (0-4 scale), and regression equations were obtained to estimate expected scores on the test from the course grades and to estimate the expected grades in the course from the test scores. Additionally, analyses were performed to estimate the accuracy of placement that would be expected to result from use of each test score value as a possible decision score. A table of possible decision scores was prepared for departmental consideration.

Results

Tables 1.1 to1.4 were prepared by the MEC to present the results of the validity study to the Division of Biological Sciences in August 1991. The analyses were based upon test scores and course grades for 79 students.

Table 1.1 shows the frequency distribution of the test scores (column to left) crosstabulated with the five grade groups of *F* through *A* (columns 3-7) and for the total group of 79 students (column to right). Toward the bottom of the table are (a) the number and percentage of students in each grade group and in the total group and (b) the mean test score and standard deviation for each grade group and for the total group. At the bottom right are the mean final course grade (2.62) and the standard deviation (0.99) of those grades, the mean test score (34.84) and the standard deviation (6.87) of those scores, and the coefficient of correlation (.86) between the test scores and the course grades. (The value of this coefficient of correlation was inflated because the test scores constituted a part of the final examination scores, which in turn constituted a part of the final course grades.)

Also at the right of the table are the two regression equations used to estimate the Expected Scores (bottom row) and the Expected Grades (second column). For example, the minimally satisfactory grade of *C* (2.02) was expected for the group of students with a test score of 30. For the group of students who made grades of *C* , the Expected Score on the test was 31.14.

Table 1.2 presents the same descriptive statistics for the total group that was represented in Table 1.1, but the five grade groups are collapsed into two academic performance groups: Unsatisfactory (grades of *F* and *D*, or 0 and 1) and Satisfactory (grades of *C*, *B*, and *A*, or 2, 3, and 4). The number and percentage of students in each academic performance group, the mean test score, and the standard deviation for each group appear in the bottom two rows of the table.

Table 1.3 presents the expected accuracies of placement for 11 possible decision scores. At the left are the placement categories (possible decision scores). The second and third sets of

Table 1.1

Scores on The UT Austin Test in Biology 302 in Relation To Student Performance in Biology 302: Frequency Distributions, Descriptive Statistics, Regression Equations, Expected Grades, and Expected Scores
Summer 1991
(N = 79)

		Final Grades in Biology 302					
Test Scores	Expected Grades	0 F	1 D	2 C	3 B	4 A	Total N
47	4.00					2	2
46	4.00					3	3
45	3.88						
44	3.75					1	1
43	3.63					2	2
42	3.51				1	3	4
41	3.38				3	1	4
40	3.26				5	1	6
39	3.13				7		7
38	3.01			1	4	1	6
37	2.89			1	1	1	3
36	2.76			2	2		4
35	2.64						
34	2.52			1	3		4
33	2.39			1	3		4
32	2.27			3	2		5
31	2.14			3			3
30	2.02		2	1			3
29	1.90		1	1	1		3
28	1.77		1	2			3
27	1.65			1			1
26	1.53		1				1
25	1.40		2	1			3
24	1.28						
23-17	1.15-0.41	1	4	2			7
Total		1	11	20	32	15	79
%		1%	14%	25%	41%	19%	100%
Mean Score		17.00	25.82	30.70	37.28	42.93	34.84
Standard Deviation		0.00	2.85	4.41	3.25	3.02	6.87
Expected Score		19.24	25.19	31.14	37.10	43.05	

Expected Grade = (Test Score x 0.1238) - 1.6936

Expected Score = (Final Grade x 5.9532) + 19.2365

Mean Grade	Standard Deviation
2.62	0.99

Coefficient of Correlation
r = .86

Table 1.2

Scores on The UT Austin Test in Biology 302 in Relation to Student Performance in Biology 302: Combined Frequency Distributions and Descriptive Statistics
Summer 1991
(N = 79)

	Final Grades in Biology 302		
Test Scores	Unsatisfactory 0,1	Satisfactory 2-4	Total N
47		2	2
46		3	3
45			
44		1	1
43		2	2
42		4	4
41		4	4
40		6	6
39		7	7
38		6	6
37		3	3
36		4	4
35			
34		4	4
33		4	4
32		5	5
31		3	3
30	2	1	3
29	1	2	3
28	1	2	3
27		1	1
26	1		1
25	2	1	3
24			
23 - 17	5	2	7
Total	12	67	79
%	15%	85%	100%
Mean Score	25.08	36.58	34.84
Standard Deviation	3.66	5.70	6.87

Mean Grade	Standard Deviation
2.62	0.99

Coefficient of Correlation
r = .86

Table 1.3

Scores on The UT Austin Test for Biology 302 in Relation to Student Performance in Biology 302: Possible Decision Scores and Corresponding Accuracies of Placement
Summer 1991
(N = 79)

Place-ment Category	Cumulative Number of Students				Percent of Students in Each Placement Category			Overall Accuracy of Placement		
	Unsatisfactory 0,1 (N = 12)		Satisfactory 2-4 (N = 67)		Unsatisfactory		Satisfactory	Placement Accuracy	Number of Students	% of Students
35-up	Too High	0	42	Correct	Too High	0%	63% Correct	Too High	0	0%
								Correct	54	68%
Below 35	Correct	12	25	Too Low	Correct	100%	37% Too Low	Too Low	25	32%
34 - up	Too High	0	46	Correct	Too High	0%	69% Correct	Too High	0	0%
								Correct	58	73%
Below 34	Correct	12	21	Too Low	Correct	100%	31% Too Low	Too Low	21	27%
33- up	Too High	0	50	Correct	Too High	0%	75% Correct	Too High	0	0%
								Correct	62	78%
Below 33	Correct	12	17	Too Low	Correct	100%	25% Too Low	Too Low	17	22%
32 - up	Too High	0	55	Correct	Too High	0%	82% Correct	Too High	0	0%
								Correct	67	85%
Below 32	Correct	12	12	Too Low	Correct	100%	18% Too Low	Too Low	12	15%
31 - up	Too High	0	58	Correct	Too High	0%	87% Correct	Too High	0	0%
								Correct	70	89%
Below 31	Correct	12	9	Too Low	Correct	100%	13% Too Low	Too Low	9	11%
30 - up	Too High	2	59	Correct	Too High	17%	88% Correct	Too High	2	3%
								Correct	69	87%
Below 30	Correct	10	8	Too Low	Correct	83%	12% Too Low	Too Low	8	10%
29 - up	Too High	3	61	Correct	Too High	25%	91% Correct	Too High	3	4%
								Correct	70	89%
Below 29	Correct	9	6	Too Low	Correct	75%	9% Too Low	Too Low	6	8%
28 - up	Too High	4	63	Correct	Too High	33%	94% Correct	Too High	4	5%
								Correct	71	90%
Below 28	Correct	8	4	Too Low	Correct	67%	6% Too Low	Too Low	4	5%
27 - up	Too High	4	64	Correct	Too High	33%	96% Correct	Too High	4	5%
								Correct	72	91%
Below 27	Correct	8	3	Too Low	Correct	67%	4% Too Low	Too Low	3	4%
26 - up	Too High	5	64	Correct	Too High	42%	96% Correct	Too High	5	6%
								Correct	71	90%
Below 26	Correct	7	3	Too Low	Correct	58%	4% Too Low	Too Low	3	4%
25 - up	Too High	7	65	Correct	Too High	58%	97% Correct	Too High	7	9%
								Correct	70	89%
Below 25	Correct	5	2	Too Low	Correct	42%	3% Too Low	Too Low	2	3%

Table 1.4

Scores on The UT Austin Test in Biology 302 in Relation to Student Performance in Biology 302: Scores Suggested by Six Guidelines for Use in Selecting Decision Scores
Summer 1991
(N = 79)

Guideline	UT Austin Biology Test Score
1. Expected Score for students whose performance in course was just minimally satisfactory (i.e., students with final grades of *C*; see Expected Score row at bottom of Table 1.1).	31
2. Score for which Expected Grade was just minimally satisfactory (i.e., *C*; see Expected Grade column in Table 1.1).	30
3. Score for which percents of errors of students in each academic performance category (Unsatisfactory, Satisfactory) were most nearly equal. (See % Too High and % Too Low values in middle columns of Table 1.3.)	30
4. Score for which overall percents of errors were most nearly equal. (See % Too High and % Too Low values in last column of Table 1.3.)	28
5. Score that would have cut off (or held back) approximately the same number of students as were in the Unsatisfactory performance group. (See Table 1.2 for number of students in the Unsatisfactory group and the test score that most nearly identifies that number of low-scoring students.)	28
6. Score that would have maximized overall accuracy of placement. (See number Correct in next-to-last column of Table 1.3.)	27

columns give the numbers and percentages of students who, in each of the two academic performance categories, would have been placed too high and correctly (Unsatisfactory group) and correctly and too low (Satisfactory group) by use of each of the 11 possible decision scores. For example, if 30 had been the placement decision score, two of the students (17%) in the Unsatisfactory Final Grade category would have been placed too high, while eight of the students (12%) in the Satisfactory Final Grade category would be placed too low. The column entries also report the numbers and percentages of accurately placed students at each of the score placement categories. The last set of columns gives the overall accuracy of placement, by number and percentage, for both academic performance categories combined.

Table 4.1 lists six guidelines suggested by various authorities for selecting decision scores for use in a program of course placement and credit by examination. Each guideline refers the reader to one of the preceding tables. In this validity study, the test scores recommended by the six guidelines range from 27 to 31.

Discussion and Decision Making

During the August 1991 meeting with the chairperson of the Division of Biological Sciences, MEC staff members recommended 31 as the decision score for students in the *C* range. A score of 31 corresponds to the Expected Score estimated by the regression procedure for the students who earned a grade of *C* in Biology 302 (see Guideline 1 of Table 1.4). The Expected Scores of students who received Biology 302 final grades of *B* and *A*, respectively, are 37 and 43 (see Expected Score row at the bottom of Table 1.1). The following score ranges for credit by examination in Biology 302 were recommended by MEC staff members and approved by the Division of Biological Sciences:

Test Score Range	Credit and Letter Grade
43-50	Credit with Grade of *A*
37-42	Credit with Grade of *B*
31-36	Credit with Grade of *C*

BIOLOGY 303

The Measurement and Evaluation Center simultaneously conducted the Biology 302 and Biology 303 validity studies and utilized identical procedures when analyzing the data sets for the two courses. The following description of method and results of the Biology 303 validity study does not repeat some of the explanations contained in the preceding presentation of Biology 302 results.

Method

Subjects

Sixty-eight (68) students who were enrolled in Biology 303 during the first summer term of 1991 served as subjects. Biology 303 is an introduction to the anatomy, reproduction, physiology, development, behavior, and evolution of microbes, plants, and animals. Biology 302 with a grade of at least a *C* is a prerequisite for Biology 303.

Materials

The UT Austin Test for Credit in Biology 303 was prepared by faculty members of the Division of Biological Sciences. It is a one-hour test designed to cover the content of the course and consists of 50 multiple-choice items.

Results

Tables 2.1 to 2.4 present the results of the validity study; the analyses were based on test scores and final course grades for the 68 students enrolled in Biology 303.

Table 2.1 shows the mean course grade (2.04) and the standard deviation (1.08) of those grades, the mean test score (40.09) and the standard deviation (5.40) of those scores, and the coefficient of correlation (.85) between the test scores and the final course grades.

The six guidelines of Table 2.4 recommend decision scores of 39 and 40.

Discussion and Decision Making

During the August 1991 meeting with the chairperson of the Division of Biological Sciences, MEC staff members recommended 39 as the decision score for students in the *C* range. A score of 39 represents the Expected Score of students who earned grades of approximately *C*– in Biology

303, and 43 and 47 represent the Expected Scores of students who received grades of approximately *B*– and *A*–, respectively. The following score ranges for credit by examination in Biology 303 were recommended by MEC staff members and approved by the Division of Biological Sciences:

Test Score Range	Credit and Letter Grade
47-50	Credit with Grade of *A*
43-46	Credit with Grade of *B*
39-42	Credit with Grade of *C*

Table 2.1

Scores on The UT Austin Test in Biology 303 in Relation To Student Performance in Biology 303: Frequency Distributions, Descriptive Statistics, Regression Equations, Expected Grades, and Expected Scores
Summer 1991
(N = 68)

		Final Grades in Biology 303					
Test Scores	Expected Grades	0 F	1 D	2 C	3 B	4 A	Total N
49	3.57					1	1
48	3.40				1	2	3
47	3.23				1	1	2
46	3.05				4	1	5
45	2.88				3		3
44	2.71			2	2		4
43	2.54			2	3		5
42	2.37		1	5	3		9
41	2.20		1	3	1		5
40	2.03			4	1		5
39	1.86		1	6			7
38	1.69		2				2
37	1.52		1				1
36	1.35		2				2
35	1.18						
34	1.01	2	2	1			5
33	0.84		1	1			2
32	0.66	2	1	1			4
31	0.49						
30	0.32						
29	0.15						
28 - 25	0.00-0.00	3					3
Total		7	12	25	19	5	68
%		10%	18%	37%	28%	7%	100%
Mean Score		30.00	36.67	40.00	44.11	47.60	40.09
Standard Deviation		3.59	2.98	3.02	2.10	1.02	5.40
Expected Score		31.44	35.67	39.90	44.13	48.36	

Expected Grade = (Test Score x 0.1707) - 4.7976

Expected Score = (Final Grade x 4.2316) + 31.4384

Mean Grade	Standard Deviation
2.04	1.08

Coefficient of Correlation
r = .85

Table 2.2

Scores on The UT Austin Test in Biology 303 in Relation to Student Performance in Biology 303: Combined Frequency Distributions and Descriptive Statistics
Summer 1991
(N = 68)

	Final Grades in Biology 303		
Test Scores	Unsatisfactory 0,1	Satisfactory 2-4	Total N
49		1	1
48		3	3
47		2	2
46		5	5
45		3	3
44		4	4
43		5	5
42	1	8	9
41	1	4	5
40		5	5
39	1	6	7
38	2		2
37	1		1
36	2		2
35			
34	4	1	5
33	1	1	2
32	3	1	4
31			
30			
29			
28 - 25	3		3
Total	19	49	68
%	28%	72%	100%
Mean Score	34.21	42.37	40.09
Standard Deviation	4.55	3.65	5.40

Mean Grade	Standard Deviation
2.04	1.08

Coefficient of Correlation
r = .85

Table 2.3

Scores on The UT Austin Test for Biology 303 in Relation to Student Performance in Biology 303: Possible Decision Scores and Corresponding Accuracies of Placement
Summer 1991
(N = 68)

Placement Category	Cumulative Number of Students				Percent of Students in Each Placement Category			Overall Accuracy of Placement		
	Unsatisfactory 0,1 (N = 19)		Satisfactory 2-4 (N = 49)		Unsatisfactory		Satisfactory	Placement Accuracy	Number of Students	% of Students
43 - up	Too High	0	23	Correct	Too High	0%	47% Correct	Too High	0	0%
								Correct	42	62%
Below 43	Correct	19	26	Too Low	Correct	100%	53% Too Low	Too Low	26	38%
42 - up	Too High	1	31	Correct	Too High	5%	63% Correct	Too High	1	1%
								Correct	49	72%
Below 42	Correct	18	18	Too Low	Correct	95%	37% Too Low	Too Low	18	26%
41 - up	Too High	2	35	Correct	Too High	11%	71% Correct	Too High	2	3%
								Correct	52	76%
Below 41	Correct	17	14	Too Low	Correct	89%	29% Too Low	Too Low	14	21%
40 - up	Too High	2	40	Correct	Too High	11%	82% Correct	Too High	2	3%
								Correct	57	84%
Below 40	Correct	17	9	Too Low	Correct	89%	18% Too Low	Too Low	9	13%
39- up	Too High	3	46	Correct	Too High	16%	94% Correct	Too High	3	4%
								Correct	62	91%
Below 39	Correct	16	3	Too Low	Correct	84%	6% Too Low	Too Low	3	4%
38 - up	Too High	5	46	Correct	Too High	26%	94% Correct	Too High	5	7%
								Correct	60	88%
Below 38	Correct	14	3	Too Low	Correct	74%	6% Too Low	Too Low	3	4%
37 - up	Too High	6	46	Correct	Too High	32%	94% Correct	Too High	6	9%
								Correct	59	87%
Below 37	Correct	13	3	Too Low	Correct	68%	6% Too Low	Too Low	3	4%
36 - up	Too High	8	46	Correct	Too High	42%	94% Correct	Too High	8	12%
								Correct	57	84%
Below 36	Correct	11	3	Too Low	Correct	58%	6% Too Low	Too Low	3	4%
35 - up	Too High	8	46	Correct	Too High	42%	94% Correct	Too High	8	12%
								Correct	57	84%
Below 35	Correct	11	3	Too Low	Correct	58%	6% Too Low	Too Low	3	4%
34 - up	Too High	12	47	Correct	Too High	63%	96% Correct	Too High	12	18%
								Correct	54	79%
Below 34	Correct	7	2	Too Low	Correct	37%	4% Too Low	Too Low	2	3%
33 - up	Too High	13	48	Correct	Too High	68%	98% Correct	Too High	13	19%
								Correct	54	79%
Below 33	Correct	6	1	Too Low	Correct	32%	2% Too Low	Too Low	1	1%

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